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1 Gestures: SHARK²: a large vocabulary shorthand writing system for pen-based computers
Per-Ola Kristensson, Shumin Zhai
October 2004 **Proceedings of the 17th annual ACM symposium on User interface software and technology**
Publisher: ACM Press
Full text available: pdf(321.66 KB) Additional Information: full citation, abstract, references, index terms

Zhai and Kristensson (2003) presented a method of speed-writing for pen-based computing which utilizes gesturing on a stylus keyboard for familiar words and tapping for others. In SHARK², we eliminated the necessity to alternate between the two modes of writing, allowing any word in a large vocabulary (e.g. 10,000-20,000 words) to be entered as a shorthand gesture. This new paradigm supports a gradual and seamless transition from visually guided tracing to recall-based ges ...

Keywords: gesture recognition, shorthand, shorthand recognition, stenography, text input

2 Gesture and interaction: Fluid inking: augmenting the medium of free-form inking with gestures
Robert Zeleznik, Timothy Miller
June 2006 **Proceedings of the 2006 conference on Graphics interface GI '06**
Publisher: Canadian Information Processing Society
Full text available: pdf(230.04 KB) Additional Information: full citation, abstract, references, index terms

We present Fluid Inking, a generally applicable approach to augmenting the fluid medium of free-form inking with gestural commands. Our approach is characterized by four design criteria, including: 1) pen-based hardware impartiality: all interactions can be performed with a button-free stylus, the minimal input hardware requirement for inking, and the least common denominator device for pen-based systems ranging from PDAs to whiteboards; 2) performability: gestures use short sequences of simple ...

Keywords: button-free, gestures, inking, tablet computing, terminal punctuation

3 Gesture and interaction: Phrasing techniques for multi-stroke selection gestures
Ken Hinckley, Francois Guimbretiere, Maneesh Agrawala, Georg Apitz, Nicholas Chen

June 2006 **Proceedings of the 2006 conference on Graphics interface GI '06**
Publisher: Canadian Information Processing Society
Full text available: pdf(350.91 KB) Additional Information: full citation, abstract, references, index terms

Pen gesture interfaces have difficulty supporting arbitrary multiple-stroke selections because lifting the pen introduces ambiguity as to whether the next stroke should add to the existing selection, or begin a new one. We explore and evaluate techniques that use a non-preferred-hand button or touchpad to phrase together one or more independent pen strokes into a unitary multi-stroke gesture. We then illustrate how such phrasing techniques can support multiple-stroke selection gestures with tapp ...

Keywords: gestures, multiple strokes, pen input, phrasing, tablets

4 Manipulating simulated objects with real-world gestures using a force and position sensitive screen
Margaret R. Minsky
January 1984 **ACM SIGGRAPH Computer Graphics , Proceedings of the 11th annual conference on Computer graphics and interactive techniques SIGGRAPH '84**, Volume 18 Issue 3
Publisher: ACM Press
Full text available: pdf(1.20 MB) Additional Information: full citation, abstract, references, citings, index terms

A flexible interface to computing environments can be provided by gestural input. We describe a prototype system that recognizes some types of single-finger gestures and uses these gestures to manipulate displayed objects. An experimental gesture input device yields information about single finger gestures in terms of position, pressure, and shear forces on a screen. The gestures are classified by a "gesture parser" and used to control actions in a fingerpainting program, an int ...

Keywords: Computers and education, Gesture, Paint programs, Touch-sensitive screen, Visual programming

5 Multi-finger and whole hand gestural interaction techniques for multi-user tabletop displays
Mike Wu, Ravin Balakrishnan
November 2003 **Proceedings of the 16th annual ACM symposium on User interface software and technology**
Publisher: ACM Press
Full text available: pdf(1.10 MB) mov(3:4 MIN) wmv(3:4 MIN) Additional Information: full citation, abstract, references, citings, index terms

Recent advances in sensing technology have enabled a new generation of tabletop displays that can sense multiple points of input from several users simultaneously. However, apart from a few demonstration techniques [17], current user interfaces do not take advantage of this increased input bandwidth. We present a variety of multifinger and whole hand gestural interaction techniques for these displays that leverage and extend the types of actions that people perform when interacting on real physi ...

Keywords: collaborative and competitive applications, gestures, multi degree-of-freedom input, tabletop interaction

6 Long papers: natural language and gestural input: Relaxing stylus typing precision by

geometric pattern matching
Per-Ola Kristensson, Shumin Zhai
January 2005 **Proceedings of the 10th international conference on Intelligent user interfaces**
Publisher: ACM Press
Full text available: pdf(219.35 KB) Additional Information: full citation, abstract, references, index terms

Fitts' law models the inherent speed-accuracy trade-off constraint in stylus typing. Users attempting to go beyond the Fitts' law speed ceiling will tend to land the stylus outside the targeted key, resulting in erroneous words and increasing users' frustration. We propose a geometric pattern matching technique to overcome this problem. Our solution can be used either as an enhanced spell checker or as a way to enable users to escape the Fitts' law constraint in stylus typing, potentially result ...

Keywords: Fitts' law, spell checker, stylus keyboard, text input, typing correction, typing errors, virtual keyboard

7 Input interaction: Shorthand writing on stylus keyboard
Shumin Zhai, Per-Ola Kristensson
April 2003 **Proceedings of the SIGCHI conference on Human factors in computing systems**
Publisher: ACM Press
Full text available: pdf(275.25 KB) Additional Information: full citation, abstract, references, citings, index terms

We propose a method for computer-based speed writing, SHARK (shorthand aided rapid keyboarding), which augments stylus keyboarding with shorthand gesturing. SHARK defines a shorthand symbol for each word according to its movement pattern on an optimized stylus keyboard. The key principles for the SHARK design include high efficiency stemmed from layout optimization, duality of gesturing and stylus tapping, scale and location independent writing, Zipf's law, and skill transfer from tapping to sho ...

Keywords: handheld devices, mobile, pervasive computing, text input, text-entry

8 Pointing: Interacting with large displays from a distance with vision-tracked multi-finger gestural input
Shahzad Malik, Abhishek Ranjan, Ravin Balakrishnan
October 2005 **Proceedings of the 18th annual ACM symposium on User interface software and technology UIST '05**
Publisher: ACM Press
Full text available: pdf(1.68 MB) Additional Information: full citation, abstract, references, index terms

We explore the idea of using vision-based hand tracking over a constrained tabletop surface area to perform multi-finger and whole-hand gestural interactions with large displays from a distance. We develop bimanual techniques to support a variety of asymmetric and symmetric interactions, including fast targeting and navigation to all parts of a large display from the comfort of a desk and chair, as well as techniques that exploit the ability of the vision-based hand tracking system to provide mu ...

Keywords: asymmetric, bimanual, from afar, gesture, interaction, large wall, multi-point, symmetric, touch surface, two hands, visual touchpad

9 Tapping vs. circling selections on pen-based devices: evidence for different performance-shaping factors

Sachi Mizobuchi, Michiaki Yasumura
April 2004 **Proceedings of the SIGCHI conference on Human factors in computing systems**
Publisher: ACM Press
Full text available: pdf(340.47 KB) Additional Information: full citation, abstract, references, index terms

Tapping-based selection methods for handheld devices may need to be supplemented with other approaches as increasingly complex tasks are carried out using those devices. Circling selection methods (such as the Lasso) allow users to select objects on a touch screen by circling with a pen. An experimental comparison of the selection time and accuracy between a circling method and a traditional tapping style of selection was carried out. The experiment used a two dimensional grid (varying in terms ...

Keywords: gesture input, handheld devices, input and interaction technologies, pen user interface, target selection

10 Short Talks: The sound of one hand: a wrist-mounted bio-acoustic fingertip gesture interface
Brian Amento, Will Hill, Loren Terveen
April 2002 **CHI '02 extended abstracts on Human factors in computing systems**
Publisher: ACM Press
Full text available: pdf(320.04 KB) Additional Information: full citation, abstract, references

Two hundred and fifty years ago the Japanese Zen master Hakuin asked the question, "What is the Sound of the Single Hand?" This koan has long served as an aid to meditation but it also describes our new interaction techinique. We discovered that gentle fingertip gestures such as tapping, rubbing, and flicking make quiet sounds that travel by bone conduction throughout the hand. A small wristband-mounted contact microphone can reliably and inexpensively sense these sounds. We harnessed this "soun ...

Keywords: acoustics, fingers, gestural interfaces, gestures, human-computer interaction, mobile devices, wrist

11 Short Talks: Using a gestural interface toolkit for tactile input to a dynamic virtual space
Thecla Schiphorst, Robb Lovell, Norman Jaffe
April 2002 **CHI '02 extended abstracts on Human factors in computing systems**
Publisher: ACM Press
Full text available: pdf(142.51 KB) Additional Information: full citation, abstract, references

In this paper, we describe the development of a gesture interface toolkit that has been applied to an application of tactile gesture recognition within an artificial life environment. The goal is to design a gestural semantics of caress, in which qualitative attributes of gesture are expressed as a function of tactility. A touch-sensitive tablet capable of detecting multiple simultaneous contacts was used to provide a source of tactile gestures (stroking, pressing, tapping, wrapping, spreading, ...

Keywords: CAVE, Laban Effort-Shape analysis, Max/MSP, Tactex MTC, gestural analysis, gesture recognition, gesture toolkit, gesture-based interface, immersive environment, movement analysis, tactile input, whole hand input

12 Hands-free multi-scale navigation in virtual environments
Joseph J. LaViola, Daniel Acevedo Feliz, Daniel F. Keefe, Robert C. Zeleznik
March 2001 **Proceedings of the 2001 symposium on Interactive 3D graphics**

Publisher: ACM Press
Full text available: pdf(155.62 KB) Additional Information: full citation, references, citings, index terms

Keywords: auto rotation, gestural interaction, navigation techniques, virtual reality

13 Speech, Audio, Gesture: Gestural and audio metaphors as a means of control for mobile devices

Antti Pirhonen, Stephen Brewster, Christopher Holguin

April 2002 **Proceedings of the SIGCHI conference on Human factors in computing systems: Changing our world, changing ourselves**
Publisher: ACM Press
Full text available: pdf(464.75 KB) Additional Information: full citation, abstract, references, citings, index terms

This paper discusses the use of gesture and non-speech audio as ways to improve the user interface of a mobile music player. Their key advantages mean that users could use a player without having to look at its controls when on the move. Two very different evaluations of the player took place: one based on a standard usability experiment (comparing the new player to a standard design) and the other a video analysis of the player in use. Both of these showed significant usability improvements for ...

Keywords: evaluation, gestures, metaphor, mobile computing, non-speech audio

14 Small devices 1: AppLens and launchTile: two designs for one-handed thumb use on small devices

Amy K. Karlson, Benjamin B. Bederson, John SanGiovanni

April 2005 **Proceedings of the SIGCHI conference on Human factors in computing systems**
Publisher: ACM Press
Full text available: pdf(467.29 KB) Additional Information: full citation, abstract, references, index terms

We present two interfaces to support one-handed thumb use for PDAs and cell phones. Both use Scalable User Interface (ScUI) techniques to support multiple devices with different resolutions and aspect ratios. The designs use variations of zooming interface techniques to provide multiple views of application data: AppLens uses tabular fisheye to access nine applications, while LaunchTile uses pure zoom to access thirty-six applications. We introduce two sets of thumb gestures, each representing d ...

Keywords: gestures, mobile devices, notification, one-handed, piccolo, thumb navigation, zoomable user interfaces (ZUIs)

15 Ubiquitous computing: Structuralizing digital ink for efficient selection

Xiang Ao, Junfeng Li, Xugang Wang, Guozhong Dai

January 2006 **Proceedings of the 11th international conference on Intelligent user interfaces IUI '06**
Publisher: ACM Press
Full text available: pdf(393.86 KB) Additional Information: full citation, abstract, references, index terms

Raw digital ink is informal and unstructured. Its editing, especially its selection, is often inefficient. In this paper, we present approaches to structuralize raw digital ink as multiple hierarchies to facilitate its selection. First a link model is built to organize ink as a mesh-

like structure. Based on the link model, the isolated stroke groups form patches. In each patch, textual and graphical areas are separated. Then, each textual area is segmented into text lines, and each text line is ...

Keywords: digital ink, selection gesture, structuralizing, text line extraction, text/graph separation

16 Visual similarity of pen gestures

A. Chris Long, James A. Landay, Lawrence A. Rowe, Joseph Michiels

April 2000 **Proceedings of the SIGCHI conference on Human factors in computing systems**

Publisher: ACM Press

Full text available: pdf(972.81 KB) Additional Information: full citation, abstract, references, citings, index terms

Pen-based user interfaces are becoming ever more popular. Gestures (i.e., marks made with a pen to invoke a command) are a valuable aspect of pen-based UIs, but they also have drawbacks. The challenge in designing good gestures is to make them easy for people to learn and remember. With the goal of better gesture design, we performed a pair of experiments to determine why users find gestures similar. From these experiments, we have derived a computational model for predicting perceived gestur ...

Keywords: multi-dimensional scaling, pen gestures, pen-based user interfaces, perception, similarity

17 Dasher—a data entry interface using continuous gestures and language models

David J. Ward, Alan F. Blackwell, David J. C. MacKay

November 2000 **Proceedings of the 13th annual ACM symposium on User interface software and technology**

Publisher: ACM Press

Full text available: pdf(110.32 KB) Additional Information: full citation, references, citings, index terms

Keywords: adaptive, entry, language, modelling, text

18 Regular contributions: Human-centered interaction with documents

Andreas Dengel, Stefan Agne, Bertin Klein, Achim Ebert, Matthias Deller

October 2006 **Proceedings of the 1st ACM international workshop on Human-centered multimedia HCM '06**

Publisher: ACM Press

Full text available: pdf(767.95 KB) Additional Information: full citation, abstract, references, index terms

In this paper, we discuss a new user interface, a complementary environment for the work with personal document archives, i.e. for document filing and retrieval. We introduce our implementation of a spatial medium for document interaction, explorative search and active navigation, which exploits and further stimulates the human strengths of visual information processing. Our system achieves a high degree of immersion of the user, so that he/she forgets the artificiality of his/her environment. T ...

Keywords: 3D displays, 3D user interface, data glove, gesture recognition, immersion

19 Late breaking result papers: MiniMedia surfer: browsing video segments on small

displays
Maryam Kamvar, Patrick Chiu, Lynn Wilcox, Sandeep Casi, Surapong Lertsithichai
April 2004 **CHI '04 extended abstracts on Human factors in computing systems**
Publisher: ACM Press
Full text available: pdf(400.76 KB) Additional Information: full citation, abstract, references, index terms

It is challenging to browse multimedia on mobile devices with small displays. We present *MiniMedia Surfer,* a prototype application for interactively searching a multimedia collection for video segments of interest. Transparent layers are used to support browsing subtasks: keyword query, exploration of results through keyframes, and playback of video. This layered interface smoothly blends the key tasks of the browsing process and deals with the small screen size. During exploration, the u ...

Keywords: multimedia, pen-based computers, small displays, video

20 Touch-sensing input devices
Ken Hinckley, Mike Sinclair
May 1999 **Proceedings of the SIGCHI conference on Human factors in computing systems: the CHI is the limit**
Publisher: ACM Press
Full text available: pdf(1.23 MB) Additional Information: full citation, abstract, references, citings, index terms

We can touch things, and our senses tell us when our hands are touching something. But most computer input devices cannot detect when the user touches or releases the device or some portion of the device. Thus, adding touch sensors to input devices offers many possibilities for novel interaction techniques. We demonstrate the TouchTrackball and the Scrolling TouchMouse, which use unobtrusive capacitance sensors to detect contact from the users hand without requiring pressure or mechan ...

Keywords: haptic input, input devices, interaction techniques, sensor technologies, tactile input, touch-sensing devices

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